Space Weather Technical Forecast

Issued on Monday, 30 January 2023 at 00:57 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight chance of R1/R2 Radio Blackouts. Slight chance of G1/Minor Storm Days 2 and 3 (31 Jan-01 Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with isolated C-class flares, the largest a C2 peaking at 29/0012 UTC, associated with a filament eruption near the northeast limb. There are currently six sunspot regions on the visible disc, all of which appear small, weak and magnetically simple. One of these is a newly numbered region, which has been emerging near the southeast limb, this is showing a rudimentary configuration at present.

A large filament was seen lifting off the southwest quadrant at 29/2100 UTC, although no CME has been observed from this event at present. No Earth-directed CMEs were seen in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 by DSCOVR, shows that Earth is in a High Speed Stream (HSS), likely from CH71/+. Wind speed was mostly elevated, peaking at 520km/s, before gradually declining down to slightly elevated levels, currently near 470km/s. Density remains at average or slightly above average levels. The total IMF, Bt, was weak at 5nT or below. The north-south component, Bz, also varied weakly between +4/-4nT. The phi angle was predominately positive (away from the Sun) but with some slight variability throughout. Geomagnetic Activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has been at background levels throughout. High energy electron flux (greater than 2 MeV) has been at background to moderate levels, peaking at 606 pfu at 29/1705 UTC. The associated 24-hour integrated electron fluence has drifted upwards but remains well below the Active threshold, with 1.93e7 integrated pfu observed at 30/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be predominantly Low, with a slight chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are expected during this period. Earth is currently experiencing a HSS which is just starting to wane. Wind speeds are expected to slowly decline through the next couple of days, likely to ambient levels. A further pair of negative polarity coronal holes are likely to bring an increase in wind speeds later in the period. The timing of this is somewhat uncertain at present, but the most likely arrival time is considered to be sometime during Day 3 (01 Feb), with low confidence.

Geomagnetic activity is expected to be Quiet to Unsettled (Kp 0-3) for much of the period. Either on Day 2 or 3 (31 Jan-01 Feb), activity is likely to increase slightly with a chance of Active (Kp 4) intervals, and a slight chance of isolated G1/Minor Storm (Kp 5) intervals when the HSS arrives.

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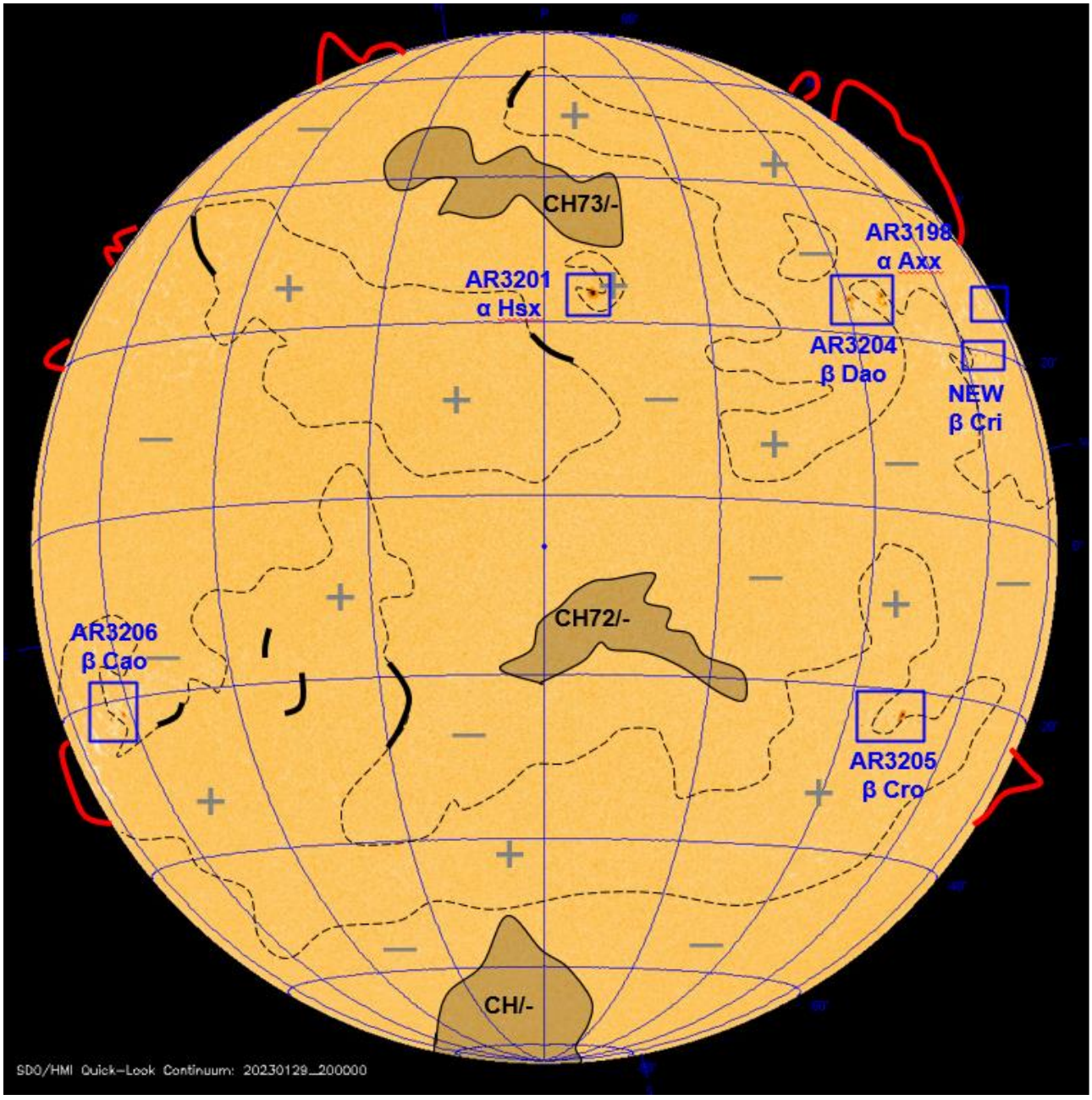
The effects of the HSS may persist into Day 4 (02 Feb), before starting to wane.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES16 is expected to remain at background levels. Electron flux may increase through the period as the HSS wanes. Fluence may also show an increasing trend over the next couple of days, although should remain below the the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 29/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are currently expected during this period.

Earth is currently experiencing a HSS, most likely from CH71/+, which is just starting to wane. Wind speeds are expected to slowly decline through the next couple of days, likely to ambient levels as seen recently at STEREO-A. A further pair of negative polarity coronal holes, CH72 and CH73, are likely to bring an increase in wind speeds once again later in the period. The timing of this is somewhat uncertain at present, with Enlil and empirical methods suggesting an increase during Day 2 (31 Jan), but persistence would imply the increase won't occur until late Day 3 (01 Feb) or perhaps even early Day 4 (02 Feb). As such, the most likely arrival time is considered to be sometime during Day 3 (01 Feb), but with low confidence.

Geomagnetic activity is expected to be Quiet to Unsettled (Kp 0-3) for much of the period. Either on Day 2 or 3, activity is likely to increase slightly with a chance of Active (Kp 4) intervals, and a slight chance of isolated G1/Minor Storm (Kp 5) intervals when the HSS arrives, which may persist into Day 4, before starting to wane.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth-directed CMEs have been observed in the past 24 hours.

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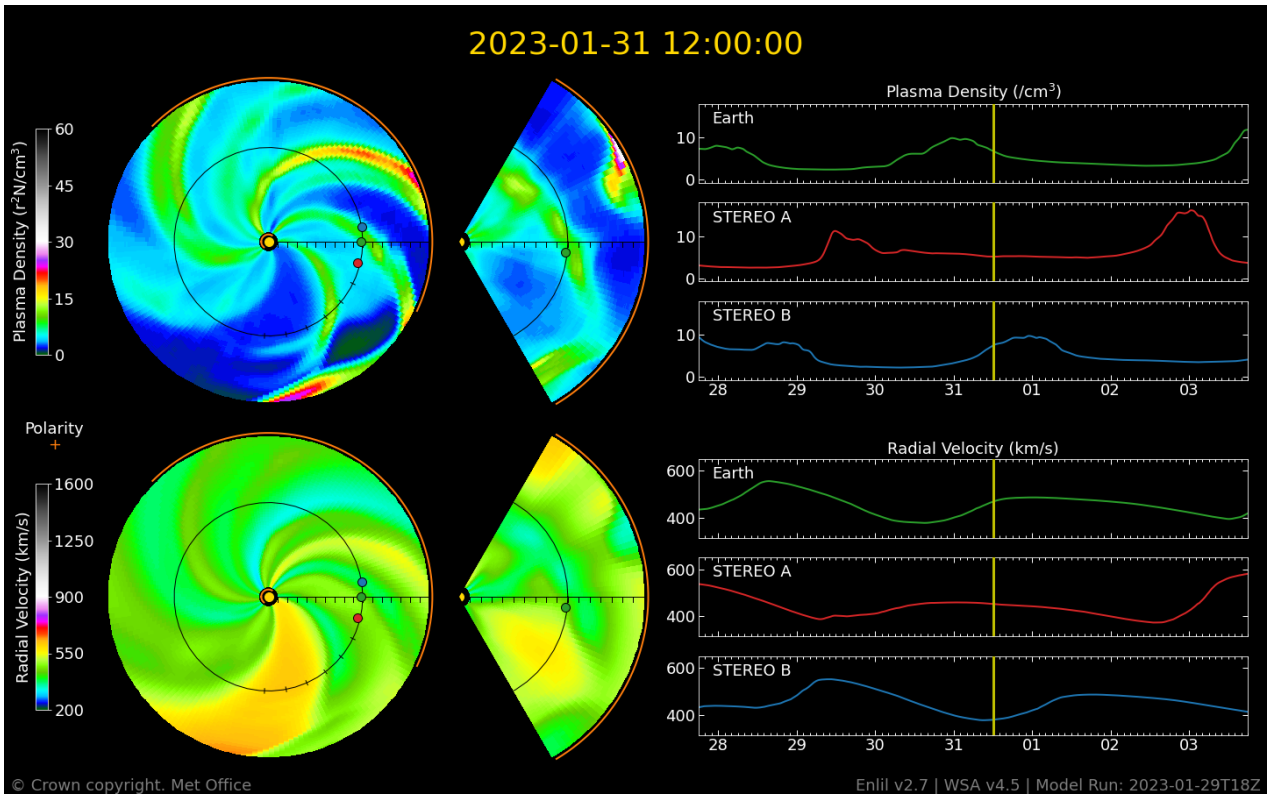
Figure 2: MOSWOC Enlil shows a decline in solar winds during today (30 Jan), before an increase on Day 2 (31 Jan), although Enlil is likely to be too early with this increase, which is more likely to occur on Day 3 (01 Feb).



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Radio Blackouts - X-Ray Flares:

Solar activity has been Low with isolated C-class flares. There are currently six sunspot regions on the visible disc, all of which are small, weak and magnetically simple. One of these is a newly numbered region which has emerged around the southeast limb, which is currently showing a rudimentary configuration. However, a better analysis of this region will be made as it continues to rotate further away from the southeast limb.

A further area of bright flux is visible in STEREO-A EUV imagery, suggesting there may be more to follow around the southeast limb, however. Solar activity is expected to be Low, with just a slight chance of an isolated M-class flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux as observed by GOES-16 is currently expected to persist at background levels. The current regions on the visible disc are all small and simple, and therefore unlikely to give any significant increase in proton counts.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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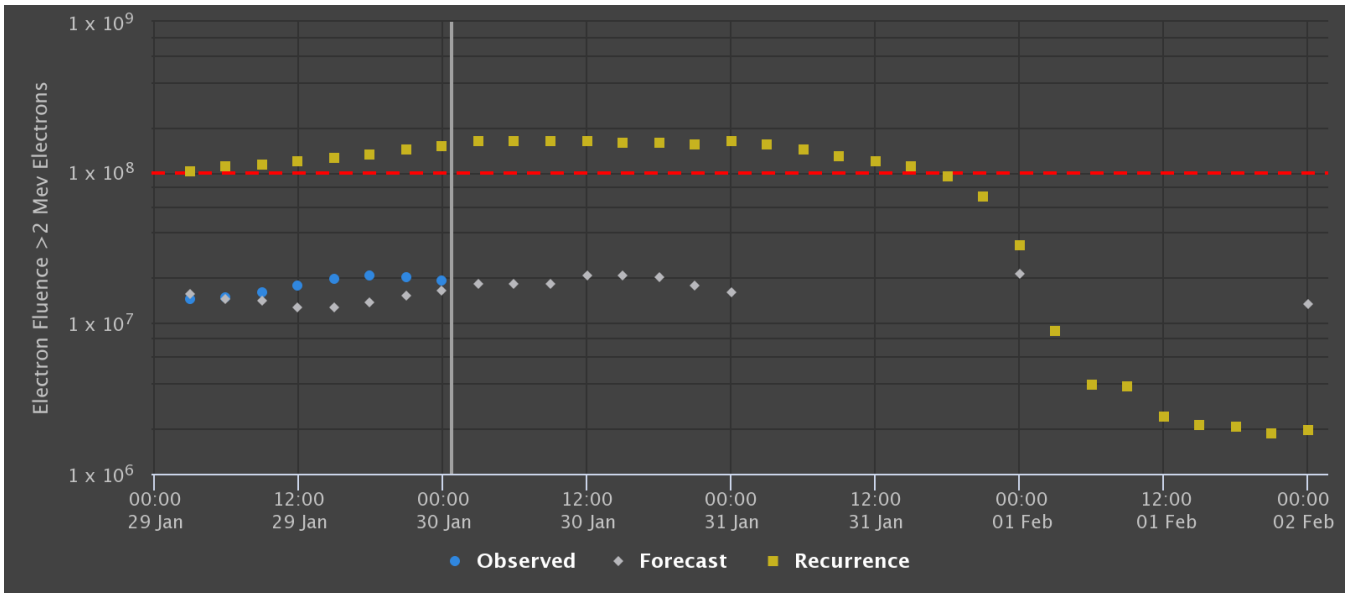
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2 MeV) is currently varying diurnally between background and moderate levels. This may show an increase as the HSS influence wanes and the radiation belts de-compress, although the level of any increase depends on how much charging has taken place during the current fast wind. The arrival of the next HSS later in the period is expected to suppress flux levels, although the timing of this arrival is low confidence (see geomagnetic storm section).

The associated 24 hour fluence may also show an increasing trend over the next couple of days with moderate confidence. REFM shows fluence staying below the Active threshold throughout the period, which seems reasonable. However, fluence did reach above Active on the previous rotation, but electron flux was higher at the equivalent of this point in time previously so levels are expected to be correspondingly lower this time around. A decrease is then possible towards the end of the period as the next HSS arrives.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	10	10	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM fluence and observations – shows a slight rising trend next few days, due to waning effects of HSS, but should remain below Active threshold throughout – especially with the arrival of the next HSS on the 01 Feb.



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